CENTRAL VALLEY FLOOD MANAGEMENT PLANNING PROGRAM

FloodSAFE CALIFORNIA

# Central Valley Flood Protection Plan

# Round 1 Management Action Workshops
## Draft Initial Management Actions

A management action is a specific structural or nonstructural strategy, action, or tactic that contributes to the Central Valley Flood Protection Plan (CVFPP) goals and addresses identified flood management problems in the Systemwide Planning Area, including any identified deficiencies in the State Plan of Flood Control (refer to *CVFPP Interim Progress Summary No.1*). Management actions may range from potential policy or institutional changes, to recommendations for operational and physical changes to the flood management system. Management actions may address one or more CVFPP goals and are the "building blocks" for regional solutions and eventually systemwide solutions.

An initial set of management actions was developed by consolidating a large number of compiled actions and recommendations from published studies and reports, and input from Regional Conditions and Topic Work Groups during CVFPP Phase 1 activities. DWR subject-matter experts provided a preliminary evaluation of the environmental, economic, technical, and social consideration of the identified management actions. Each management action was evaluated against a uniform set of criteria to allow for a consistent comparative analysis.

Management Actions Workshops will refine the initial management actions and develop additional actions to augment this initial set of management actions. For information on Phase 2 Workshops, refer to *Attendee's Guide to Phase 2 Workshops* available at www.water.ca.gov/cvfmp/.

Each management action is evaluated using the *Management Actions Evaluation Form*. For description of the form sections refer to the *Reader's Guide to the Management Actions Evaluation Form* available at www.water.ca.gov/cvfmp/.

To provide detailed written comments on the management action description and evaluation, use the fillable PDF *Comments Form* available at www.water.ca.gov/cvfmp/.

## Draft Operation & Maintenance Management Actions

| ID | Management Actions Title |
|---|---|
| MA-029 | Restore channel form and function to improve O&M and facilitate flood damage reduction. |
| MA-030 | Perform clearing and snagging within channels. |
| MA-031 | Perform dredging to remove sediment from channels. |
| MA-032 | Reuse excess materials derived from channel maintenance. |
| MA-033 | Develop regional vegetation management plans. |
| MA-034 | Improve administration of encroachment permits. |
| MA-035 | Improve administration and oversight of levee penetrations. |
| MA-036 | Improve interior drainage. |
| MA-037 | Protect vulnerable levees and banks through stabilization and erosion repairs. |
| MA-038 | Revise O&M manuals and inspection criteria to promote best maintenance practices that support multi-benefits of the flood system. |
| MA-083 | Effectively maintain and operate closure structures. |

# DRAFT Management Action Evaluation

**Management Action Title:** MA-029

Restore channel form and function to improve O&M and facilitate flood damage reduction.

**Description:**

*Problem:*

Natural river/stream channels are formed by fairly frequent runoff events. Often, these channels are not large enough to handle peak flows from larger (less frequent) floods. In addition, in many cases development have encroached into the floodplain and levee systems. This results in channels with inadequate capacity that can inhibit drainage and contribute to flooding. Narrow channels also tend to increase velocity, which can increase erosion and the risk of flood damage.

Desired Outcome:

Where applicable, channels could be enlarged enough to safely carry larger peak flows without causing excessive erosion or other damage to the flood management system.

*Methodology:*

Restoring channel form and function would involve excavating a new channel or enlarging an existing channel. This would increase channel capacity and/or decrease the channel velocity. Areas adjacent to the thalweg or low flow channel can also be used to encourage or maintain sensitive habitat while other sections of the channel prism can be maintained for flow. Restoring channel form and function could occur in an existing river channel, an existing floodway, or a transitory storage area.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retain for further evaluation

**Advantages:**

- May reduce scour and erosion.
- May increase capacity.

**Disadvantages:**

- Permitting requirements
- Temporary imperilment to aquatic and riverine ecosystems

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Channelization projects would likely require a moderate level of initial investment due to permitting requirements and the need for mitigation and structural changes to the flood system.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

Potentially decrease in the annual costs if mechanized equipment can be readily used to clear vegetation and sediment on a more regular basis without the need to initiate large scaled sediment and/or vegetation removal projects and associated permitting, design, and construction costs.

*Potential for Cost-Sharing?*

Potential for federal and local cost sharing for channelization projects that facilitate flood damage reduction or ecosystem benefits.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

No significant change in emergency response and recovery costs.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

No significant change in flood fighting cost.

*Effect on Damage to Critical Public Infrastructure?*

Reduction in flood risk could reduce damage to critical infrastructure.

*Effect on Floodplain and Economic Development?*

Channelization may improve flood system reliability and reduce risk

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Although channelization could improve the capability of the channel to carry design flows, there would likely be no significant change in State Flood Responsibility.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

Generally, channelization does not contribute to rehabilitation of ecosystem functions. However, low flow channel can be used to encourage or maintain sensitive habitat while other sections of the channel prism can be maintained for carrying flood flows.

*Adverse Environmental Impact?*

This action could result in moderate to substantial temporary (and potentially permanent) impacts to upland, riparian, and aquatic habitats, and associated special-status species, depending on the design of the action.

*Permitting Considerations?*

Extensive and complex

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

The magnitude of adverse effects to habitats resulting from flood system O&M would be reduced if a low flow channel is incorporated into the design of the action.

**Social Considerations:**

*Public Safety?*

Improves public safety by reducing flood damages.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

None.

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Likely acceptable at the State and local levels.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

Possibility for redirected hydraulic impacts due to changes in flow characteristics of the channel.

*Residual Risk?*

No significant change.

*Climate Change Adaptability:*

This action could enhance hydrologic and/or biological adaptability by increasing increasing capacity to convey flood flows, moderating damage from extreme events, and enhancing ability of habitats and species to handle (i.e., persist through or recover from) extreme events; however, effect on adaptability would depend on design of action.

**Urban, Small Community, and Non-Urban Considerations:**

No specific considerations identified.

**Regional Applicability:**

All regions

**Integration with Other Programs:**

Channel maintenance technical evaluations including hydraulic models and conveyance analysis (FMO), Evaluation of Hydraulic Carrying Capacity of Channels (HAFOO), Levee repairs Program (LRFMO)

**References:**

USACE 2001 Sacramento and San Joaquin River Basins Comprehensive Study;Boyle & Associates, 2008. Madera County Integrated Regional Water Management Plan;

# DRAFT Management Action Evaluation

**Management Action Title:** MA-030

Perform clearing and snagging within channels.

**Description:**

*Problem:*

Snags are trees, limbs, or large bushes that have fallen into a stream or river. Once in the waterway, they can collect sediment or debris. While snags provide important ecosystem benefits, they can also migrate downstream and become stuck in the channel, which creates snag "islands" and reduces channel capacity. Snags can also cause property damage by becoming caught on bridges, pumping plants, docks, and other infrastructure. Debris also creates drag and reduces channel capacity. Small debris such as branches or trash can accumulate along the banks during normal flows, but while unsightly, are not a problem during large floods. Large debris can include furniture, appliances, or other large items that may have been illegally dumped into the flood channel. These items can easily be trapped on the river banks by snags, as well as by bridges or other similar infrastructure. Large debris can create significant backwater effects that reduce flood flow capacity. Some forms of vegetation in the channels can reduce flow velocities, obstruct debris movement, and increase sedimentation. Responsibility for vegetation management is ill-defined for most channels, which further complicates channel maintenance.

Desired Outcome:

Channels should be clear of snags and large debris to maximize capacity.

*Methodology:*

Clearing and snagging could be performed to remove snags and large debris located within channels.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retain for further evaluation

**Advantages:**

- Reduce snag "islands", and increase channel capacity.
- Reduce damages to bridges, pumping plants, and other property.
- Could potentially increase channel capacity.

**Disadvantages:**

- Permitting requirements
- Significant riverine and aquatic ecosystem impacts

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Clearing and snagging projects would likely require a low level of initial investment. The lack of structural changes to the flood system would likely keep costs down relative to other actions.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

No significant change; although clearing and snagging within the channel may reduce O&M costs due to reduced sediment removal in channels, and reduced scour and erosion repair required at levees and bridges.

*Potential for Cost-Sharing?*

Potential for local cost sharing for clearing and snagging within channels.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

There would likely be no significant change in costs for emergency response and recovery.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

No significant change in flood fighting cost.

*Effect on Damage to Critical Public Infrastructure?*

Potential to reduce scour and erosion repairs at bridges and other in channel infrastructure.

*Effect on Floodplain and Economic Development?*

Clearing and snagging may improve flood system reliability, but does not reduce flood risk.

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Although clearing and snagging could potentially improve channel capacity, there would likely be no significant change in State Flood Responsibility.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

None

*Adverse Environmental Impact?*

Snagging would result in moderate to substantial temporary impacts to riparian habitat during removal and permanent impacts and loss of habitat for aquatic fish species foraging and rearing habitat including special-status species. Clearing of vegetation would result in substantial permanent impacts to riparian habitat, nesting birds, and aquatic species including special-status species.

*Permitting Considerations?*

Substantial

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

None

**Social Considerations:**

*Public Safety?*

Improves public safety by reducing flood damages.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

Clearing and snagging may provide maintenance workers better visibility for potential problems.

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Somewhat likely, but has low cost-effectiveness. In addition, this measure would reduce existing shaded riverine aquatic habitat, which is an important component to some ecosystem restoration programs.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

Possibility for redirected hydraulic impacts due to changes in flow characteristics of the channel.

*Residual Risk?*

No significant change.

*Climate Change Adaptability:*

This action would reduce biological adaptability by eliminating and simplifying habitat, and thus, reducing the ability of populations to handle and adjust to the consequences of climate change; but action could enhance hydrologic adaptability if it significantly increases flood flow capacity.

**Urban, Small Community, and Non-Urban Considerations:**

No specific considerations identified.

**Regional Applicability:**

All regions

**Integration with Other Programs:**

Vegetation Management Projects (FMO)

**References:**

USACE, 2001. Sacramento and San Joaquin River Basins Comprehensive Study;

# DRAFT Management Action Evaluation

**Management Action Title:** MA-031

Perform dredging to remove sediment from channels.

**Description:**

*Problem:*

Sedimentation of natural channels reduces their flow-carrying capacity. Historically, hydraulic mining released great quantities of sediment into some foothill streams, which was carried into the valley and deposited wherever the gradient and flow rate no longer would support the bed load transport. Even though hydraulic mining is now discontinued, portions of these sediments remain in valley streams. Sedimentation in other areas is from erosion of riverbanks and levees and runoff from agricultural fields. Natural sedimentation also deposits large quantities of silt, sand, gravel, and rock at critical points like sand traps and other low energy areas where steep foothill streams become flat valley watercourses.

Desired Outcome:

Channels should be clear of accumulated sediment to maximize capacity.

*Methodology:*

Dredging could remove sediment from channels and can improve the hydraulic efficiency. Deepening the thalweg or creating one can increase the overall flow efficiency by increasing the velocity through it.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retain for further evaluation

**Advantages:**

- Could increase channel capacity.

**Disadvantages:**

- Permitting requirements.
- Significant aquatic ecosystem impacts.
- Dredge tailings disposal - potential hazardous materials in sediment.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Dredging projects would likely require a medium to high level of initial investment. The need for mitigation and dredge tailings disposal would likely make costs higher relative to other actions.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

No significant change, although dredging may reduce O&M costs due to less scour and erosion repair.

*Potential for Cost-Sharing?*

Potential for local cost share in areas needing improved channel conveyance and limited ecosystem constraints.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

No significant change in costs for emergency response and recovery.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

No significant change in floodfighting cost.

*Effect on Damage to Critical Public Infrastructure?*

No significant change.

*Effect on Floodplain and Economic Development?*

Dredging may have little to no effect on floodplain development.

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Although dredging could potentially improve channel capacity, there would likely be no significant change in State Flood Responsibility.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

None

*Adverse Environmental Impact?*

This action would result in moderate to substantial temporary impacts to riparian and aquatic habitat (fish spawning and rearing habitat) including special-status species. It also would result in minor to moderate alteration of physical processes, including flow regime (e.g., magnitude, and duration of flows) and sediment transport, that could result in permanent impacts to habitat for aquatic and riparian species.

*Permitting Considerations?*

Considerable and extensive; can be very costly and time consuming.

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

None

**Social Considerations:**

*Public Safety?*

Improved public safety by increasing the reliability of channels to pass flood flows.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

Unlikely to provide other benefits than increasing channel capacity.

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Somewhat likely, but has low cost-effectiveness, and would need to be performed in low environmental impact areas.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

Possibility for redirected hydraulic impacts due to changes in flow characteristics of the channel.

*Residual Risk?*

No significant change.

*Climate Change Adaptability:*

This action could enhance hydrologic adaptability if it significantly increases flood flow capacity; but, action also could reduce biological adaptability by disturbing and simplifying aquatic habitats, and thus, reducing the ability of populations to handle and adjust to the consequences of climate change.

**Urban, Small Community, and Non-Urban Considerations:**

No specific considerations identified.

**Regional Applicability:**

All regions

**Integration with Other Programs:**

Delta Dredged Sediment Long-Term Management Strategy (USACE)

**References:**

USACE, 2001. Sacramento and San Joaquin River Basins Comprehensive Study; Agricultural Stewardship White Paper;

# DRAFT Management Action Evaluation

**Management Action Title:** MA-032

Reuse excess materials derived from channel maintenance.

**Description:**

*Problem:*

Waste materials are created during channel maintenance activities such as dredging and clearing and snagging. It is necessary to transport and dispose of these materials, which can be costly.

Desired Outcome:

These materials should be reused to minimize waste and transportation costs. This also reduces negative impacts to the environment including carbon emissions and disposal to landfills.

*Methodology:*

Beneficial reuses for waste materials from channel maintenance activities should be identified. Dredged sediment, if it does not contain hazardous materials, could be used as fill material in the proper locations.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☐ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retain for further evaluation

**Advantages:**

- May reduce transportation costs for disposal.
- May reduce disposal costs.

**Disadvantages:**

- Permitting requirements.
- Potential hazardous materials in sediment.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Reuse of excess material would likely require a low level of initial investment, and would likely reduce costs versus disposal.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

No significant change to operate/maintain/repair.

*Potential for Cost-Sharing?*

High potential for local cost sharing to reduce overall disposal and transportation costs associated with channel maintenance.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

There would likely be no significant change in costs for emergency response and recovery.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

No significant change in floodfighting cost.

*Effect on Damage to Critical Public Infrastructure?*

No significant change.

*Effect on Floodplain and Economic Development?*

Not likely to have an effect on floodplain development.

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Reuse of excess materials would likely provide no significant change in State Flood Responsibility.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

None

*Adverse Environmental Impact?*

None

*Permitting Considerations?*

None

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

None

**Social Considerations:**

*Public Safety?*

Unlikely to have substantial public safety impacts.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

Reuse of excess material may also reduce negative impacts to the environment including carbon emissions and disposal to landfills.

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Reuse of excess materials would be highly likely to be implemented due to the potential cost savings and reduction in negative impacts to the environment.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

No redirected hydraulic impacts.

*Residual Risk?*

N/A

*Climate Change Adaptability:*

This action is unrelated to hydrologic and biological adaptability.

**Urban, Small Community, and Non-Urban Considerations:**

No specific considerations identified.

**Regional Applicability:**

All regions

**Integration with Other Programs:**

Delta Dredged Sediment Long-Term Management Strategy (USACE)

**References:**

Agricultural Stewardship White Paper;

# DRAFT Management Action Evaluation

**Management Action Title:** MA-033

Develop regional vegetation management plans.

**Description:**

*Problem:*

When vegetation management has been deferred for several years due to funding or other constraints, excessive vegetation growth can result in the establishment of habitat that requires additional permits or mitigation before maintenance activities can be conducted. Conflicting guidance and requirements in relation to vegetation and debris management can make it difficult for local agencies with limited budgets to conduct maintenance activities efficiently. USACE has national standards that limit vegetation on levees. This policy is in conflict with the vegetation management policies of other State and federal agencies.

Desired Outcome:

Develop vegetation management plan as part of corridor management that balance public trust concerns while maintaining the functionality of the flood management system and allows for regular maintenance to ensure public safety.

*Methodology:*

Architectural Landscape designs should be developed in coordination with structural designs and Corps Vegetation Policy.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retain for further evaluation

**Advantages:**

- May improve bank stability.
- Would reduce costs of obtaining permits.
- Would provide multiple benefits along with flood risk reduction.

**Disadvantages:**

- Vegetation policy still in conflict with USACE vegetation on levee policy.
- Conflicting State and Federal public protection and public trust policies.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Unless variance is allowed by Corps to its Vegetation Policy, cost of mitigation to meet federal requirements is very high. Levee repairs have estimated intial costs varying from $6.5 billion to $7.5 billion to meet federal requirements.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

Regional vegetation management plans would slightly increase annual O&M costs, but would likely be offset by a reduction in permitting and mitigation costs.

*Potential for Cost-Sharing?*

Cost sharing is applicable only to levee vegetation management, as LMAs will provide the bulk for O&M costs. The State and the Federal governments should help offset these costs and provide funds and assistance to help LMAs with environmental permitting.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

No significant change to emergency response and recovery cost. Vegetation management will improve the reliability of the system, and may restore channel capacity

*Flood fighting? (Increase, Decrease, or No Significant Change)*

Management of vegetation on levees would reduce long-term flood fighting costs, as it visibility and access. Vegetation on channels has an indirect and relatively minor effect on flood fighting such as tree debris in the water impacting food fighting operations.

*Effect on Damage to Critical Public Infrastructure?*

Minor impact. Vegetation debris from channels could potentially accumulate at choke points (i.e. bridge crossings) obstructing and impacting flow conveyance, negatively affecting in-channel and adjacent infrastructure.

*Effect on Floodplain and Economic Development?*

Not likely to have an effect on floodplain development.

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Vegetation in channels is the responsibility of the State and Federal governments. The State has a large stake in assuring that the design flows are not reduced by vegetation. Vegetation management on levees is the responsibility of the locals, but since the State is the largest maintainer, it has a significant impact in implementing the vegetation policy.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

Regional vegetation management could rehabilitate key physical processes and ecosystem functions, if vegetation is managed to enhance physical processes, such as sediment transport and channel and floodplain forming processes, and to enhance riparian and wetland habitat values.

*Adverse Environmental Impact?*

Channel specific and unknown at this time.

*Permitting Considerations?*

Channel specific and unknown at this time.

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

Impacts associated with flood system O&M could be reduced because O&M would be better facilitated and mitigation better coordinated.

**Social Considerations:**

*Public Safety?*

Unlikely to have substantial public safety impacts.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

Developing regional vegetation management plans may enhance aesthetic, recreational and open space values within floodplains.

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Likelihood of implementation is highly dependent on the ability to meet USACE guidelines for vegetation within the project works while reducing permitting and mitigation costs.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

Possible hydraulic impacts due to riparian vegetation removal required by the Corps. Changes in local flow velocities possible.

*Residual Risk?*

There will be a net reduction in risk

*Climate Change Adaptability:*

This action would reduce biological adaptability by reducing extent and quality (e.g., by reducing connectivity and complexity) of tree and shrub-dominated riparian habitats.

**Urban, Small Community, and Non-Urban Considerations:**

No specific considerations identified.

**Regional Applicability:**

All regions

**Integration with Other Programs:**

Major Vegetation Management Projects (FMO)

**References:**

RCR; Environmental Sustainability Summary; USACE. 2007. Treatment of Vegetation within Local Flood Damage Reduction Systems. Draft White Paper;

# DRAFT Management Action Evaluation

**Management Action Title:** MA-034

Improve administration of encroachment permits.

**Description:**

*Problem:*

The CVFPB, in cooperation with the USACE, are responsible with processing, reviewing, issuing, and administrating permits for structures that encroach on project levees. The permitting process is lengthy. Currently there is a back log of about 180 days for issuing permits for new structures. In addition, there are hundreds of permitted encroachments that are not properly maintained and hundreds of unpermitted encroachments. In fall 2007, DWR identified approximately 129 miles of partially obstructing and 7 miles of completely obstructing encroachments (DWR, 2008e). Unmaintained or unpermitted encroachments may jeopardize levee integrity, raise the water surface level of design floods or flows, increase the damaging effects of flood flows, and impair inspection, maintenance and flood fighting. DWR reports newly discovered unauthorized encroachments to the Board and works with LMAs to abate unauthorized encroachments. Each LMA is held responsible for preventing the construction of, or requiring the removal of, any illegally encroaching structures on the levee and for stopping any unauthorized modifications to the levee (DWR, 2008e). However, some LMAs may lack the resources to force the removal of illegal encroachments.

Desired Outcome:

A streamlined permitting process. Proper administration of existing permits. Modernization of the permits database. More vigorous enforcement of unauthorized permits.

*Methodology:*

The State can work to improve the administration of encroachment permits by working with LMAs to remove illegal encroachments and improve enforcement of unauthorized and under-authorized permits. The State should also improve management of historic permits data by modernizing the repository of encroachment permits.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☑ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retain for further evaluation

**Advantages:**

- Will reduce the number of poorly maintained and unpermitted encroachments.
- Will make inspection of levees easier by removing encroachments.
- Will shorten the permit approval time.

**Disadvantages:**

- With the large number of unpermitted encroachments, could add significant administrative work.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Low. Policy MA's will tend to have a substantially lower capital cost than other MAs which involve physical construction.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

No significant change.

*Potential for Cost-Sharing?*

Potential cost-sharing with federal agencies, other state agencies, as well as local agencies. Before cost sharing with other entities, the CVFPB needs to modernize and stream line the permitting process.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

No change.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

Accessibility to all permits, properly categorized and spatially georeferenced, will be invaluable for the Flood Operation Center in coordinating flood fighting operations during high-water events.

*Effect on Damage to Critical Public Infrastructure?*

Improving the administration of encroachment permits would likely have no significant effect on damage to critical public infrastructure.

*Effect on Floodplain and Economic Development?*

Not likely to have an effect on floodplain development.

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Improving the administration of permitted structures will LIKELY improve flood management and the state flood responsibility as critical information will be more easily accessible.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

None.

*Adverse Environmental Impact?*

None.

*Permitting Considerations?*

The encroachment permitting process needs to be part of the overall permitting process.

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

None.

**Social Considerations:**

*Public Safety?*

Potential to improve public Safety by reducing poorly maintained and illegal encroachments.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

No immediate effect

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Feasible and likely implementable.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

None.

*Residual Risk?*

No change in residual risk.

*Climate Change Adaptability:*

This action is unrelated to hydrologic and biological adaptability.

**Urban, Small Community, and Non-Urban Considerations:**

No specific considerations identified.

**Regional Applicability:**

All regions.

**Integration with Other Programs:**

**References:**

# DRAFT Management Action Evaluation

**Management Action Title:** MA-035

Improve administration and oversight of levee penetrations.

**Description:**

*Problem:*

Many levees in the Sacramento and San Joaquin river basins have locations where irrigation lines, drainage outlets, and other utilities have been piped through the levee. Some of these penetrations are engineered but the majority are not and poses a potential threat to the integrity of the levees. Leaks through the levee resulting from the penetrations can cause excessive levee material loss. In some instances, a surface expression of the levee material loss is visible soon after the leak manifests itself, especially on sandy levee embankments. However, if the levee composition is clayey, the leak may cause internal ground loss that may not be detected until a sinkhole appears on the levee surface. These hidden voids pose a serious threat to the structural integrity of the levee, which threatens the areas protected by the levee.

Desired Outcome:

An inventory of all penetrations, permitted and otherwise, creation of a database for all penetrations, and an assessment of deficiencies associated with penetrations. Establishment of a protocol to periodically conduct non-invasive testing on levee penetrations to assess their deterioration and recommend an adequate course of action. Upgrading standards for construction of new penetrations (i.e., use of stainless steel pipe for portions of penetrations within the CVFPB right-of-way.)

*Methodology:*

Improve administration and oversight of levee penetrations by creating a data management system to track, evaluate and permit penetrations.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retain for further evaluation

**Advantages:**

- Continuous testing cycle can reveal penetrations that are deteriorating.
- They can be replaced before any damage to the levee embankment occurs.

**Disadvantages:**

- Could add significant administrative work.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Variable depending on the type and function of the penetration in question.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

Low to moderate, most of the annual costs are associated with physical testing of levee penetrations that pose the highest hazard to flood protection.

*Potential for Cost-Sharing?*

Potential cost sharing with maintainers, operators, as well as State and federal agencies.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

Low to none.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

If deficient levee penetrations are located and are repaired or replaced, flood fighting costs should decrease as result of increased structural integrity of the levee.

*Effect on Damage to Critical Public Infrastructure?*

Repairing and replacement of deficient levee penetration will improve the levee's structural integrity and lower the risks of flooding.

*Effect on Floodplain and Economic Development?*

Increase in the structural integrity of the levees and thereby lowering the risks to flooding may induce further developments.

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Although stated responsibility will not change, inability of LMAs to repair or replace deficient levee penetrations could induce the state to response.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

Project dependent - repair on or relocation of levee penetration may have temporary impacts to riparian or other habitats

*Adverse Environmental Impact?*

Project dependent - repair on or relocation of levee penetration may have temporary impacts to riparian or other habitats

*Permitting Considerations?*

Project dependent - repair on or relocation of levee penetration may have temporary impacts to riparian or other habitats

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

None.

**Social Considerations:**

*Public Safety?*

Public safety benefits could come from improving levee stability by repairing or replacing deficient levee penetrations.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

No immediate effect

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Feasible and likely implementable.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

None.

*Residual Risk?*

Knowledge of the locations of pipe encroachments leads to a better understanding of potential risks from such encroachments, leading to identification of problem locations (e.g. leaking pipes requiring retrofit/replacement), and resulting in reduced risk to the flood protection system.

*Climate Change Adaptability:*

This action is unrelated to hydrologic and biological adaptability.

**Urban, Small Community, and Non-Urban Considerations:**

Need to engage the owners and operators of levee penetrations. Small and non-urban communities may not have the necessary budget to address deficiencies found.

**Regional Applicability:**

All regions.

**Integration with Other Programs:**

Flood Control Facilities Operation and Maintenance Program (FMO) Levee Operations and Maintenance Program (FMO) Pipe Inspection Program (FMO)

**References:**

n/a

# DRAFT Management Action Evaluation

**Management Action Title:** MA-036

Improve interior drainage.

**Description:**

*Problem:*

Localized flooding can occur even while the larger conveyance paths for the mainstem rivers are performing well. Flooding can occur at local scales that nest, or influence other scales. A flood of a small stream can create discharge that leads to flooding of its receiving stream or channel. Similarly a receiving channel can flood, backing up water to the point of flooding a tributary channel. Managing the potential for flooding at each scale requires direct attention at that scale and an understanding of the likely effects that can be produced in, or delivered from watersheds of different scales.

Desired Outcome:

Improve interior drainage by channeling runoff to prevent flooding and help eliminate backwater effects and ensure each watershed has sufficient capacity.

*Methodology:*

Interior drainage could be improved by modifying or constructing new outfalls; for example, outfalls with flap gates can prevent backflow from rivers or channels into interior areas during high water events. Similarly, new or improved pump stations could convey interior drainage over levees or other flow barriers associated with the flood management system. Improvements could also include constructing new interior drainage detention/retention facilities to reduce or attenuate outflows to the flood management system.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retained; requires further evaluation to assess the potential to provide significant systemwide flood management benefits

**Advantages:**

- Reduces localized, interior flooding.
- Reduces accumulation of water behind levees.

**Disadvantages:**

- Moderate to high capital costs.
- Potential to increase outflows to flood management system.
- May not provide significant systemwide flood management benefits.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Moderate to high cost depending on specific actions/methods

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

Little or no change to O&M costs associated with flood management system; O&M costs would fall on local entities

*Potential for Cost-Sharing?*

Some opportunity for cost-sharing.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

Lower emergency response and recovery costs

*Flood fighting? (Increase, Decrease, or No Significant Change)*

Probably lower incidence of flood fighting

*Effect on Damage to Critical Public Infrastructure?*

Potential to reduce damage to critical public infrastructure through reduction in frequency or magnitude of interior flooding and accumulated water

*Effect on Floodplain and Economic Development?*

Better managing flood risk in low order watershed improves reliability of infrastructure and investments, leading to better economic development potential.

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

No change to State flood responsibility

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

Could have significant improvement, be neutral, or impair ecological functions.

*Adverse Environmental Impact?*

Possibly.

*Permitting Considerations?*

Normal

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

Some

**Social Considerations:**

*Public Safety?*

Potential to increase public safety through reduction in the frequency or magnitude of localized, interior flooding

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

Depends on specific solutions brought forward.

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Interior drainage is typically a local function and implementation would depend on local resources, needs, and acceptability

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

Little potential to increase downstream flood flows by increasing outflows from interior areas; timing of increased outflows unlikely to coincide with flood system peak flows

*Residual Risk?*

No change in residual risk

*Climate Change Adaptability:*

None

**Urban, Small Community, and Non-Urban Considerations:**

Location specific (cannot determine at this time)

**Regional Applicability:**

Applicable in all regions with interior drainage problems

**Integration with Other Programs:**

Could be fully integrated with a wide array of programs or could be pursued as single minded narrow program.

**References:**

Mokelumne/Amador/Calaveras IRWMP - Draft. November, 2006;

# DRAFT Management Action Evaluation

**Management Action Title:** MA-037

Protect vulnerable levees and banks through stabilization and erosion repairs.

**Description:**

*Problem:*

In many levee reaches, the flood control channels were designed to flush out sediments that accumulated in the Sacramento River system from hydraulic mining activities in the late 1800s. These designs altered the natural balance of erosion and deposition in the channels and flushed out a majority of the mining debris. However, with much of the debris removed, the flows are now eroding the natural channel banks and the flood protection levees placed on them. Furthermore, many of the earlier levees were not engineered and were made with readily available materials dredged from the adjacent river. Poor levee foundations, geometry, or soil materials in some areas have further exacerbated erosion problems. Without bank protection, this erosion can encroach on existing levees and ultimately result in levee failure and major flooding. Floodwaters are erosive and, while moving along typically unprotected levees, need only encounter one weak spot in the system to cause a breach and potential loss of life or property. Extremely high hydraulic gradients can find other weak spots in the foundation materials and begin to migrate, or erode material from the foundation, creating unstable conditions quickly followed by total or significant structural failure (FEAT, 1997a). This ongoing erosion causes more damage than can be repaired by the State or levee maintaining agencies (LMA) using standard maintenance programs (DWR, 2005b).

Desired Outcome:

A long range solution to perform proactive repairs on damaged sites exhibiting signs of under seepage, erosion, or instability, so they do not reach a critical state of failure.

*Methodology:*

River erosion repair and bank stabilization, particularly when done in emergency situations, are made using rock riprap to armor and stabilize the bank. If conducted as part of an ongoing inspection and maintenance program, erosion repair and bank stabilization can be made more environmentally friendly by including sloping riparian benches with vegetation on the bench for bank stabilization and riparian habitat. Instream habitat, such as log and debris structures to direct flows away from the levees could also be created as part of these repair activities.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retain for further evaluation

**Advantages:**

- Improves levee performance.
- Provides greater flood protection.

**Disadvantages:**

- Permitting requirements.
- Damage to aquatic and riverine ecosystems.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Protecting vulnerable levees and banks through stabilization and erosion repairs has a medium to high cost due to structural changes and potential mitigation as compared to other actions.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

Protecting vulnerable levees and banks through stabilization and erosion repairs can decrease annual operations and maintenance costs due to better performing levees and less erosion to repair in the future.

*Potential for Cost-Sharing?*

Potential cost-sharing with federal agencies, other state agencies, as well as local agencies.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

Protecting vulnerable levees and banks through stabilization and erosion repairs may slightly decrease the response and recovery costs due to better performing levees.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

Repairing damaged sites will decrease flood fighting costs.

*Effect on Damage to Critical Public Infrastructure?*

Region specific (cannot determine at this time)

*Effect on Floodplain and Economic Development?*

No direct effects; however, by increasing the stability of the levee, would reduce the frequency of flooding and increase level of flood protection, which may encourage development in the floodplain

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Relative to likely future conditions, may reduce the frequency of flooding, thereby could reduce State responsibility

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

Levee repairs that include riparian habitat benches and instream habitat elements would rehabilitate ecological functions, by increasing SRA cover and enhancing migration corridor habitat for fish and wildlife species.

*Adverse Environmental Impact?*

Depending on implementation, this action could result in potential temporary and permanent impacts to shaded riverine aquatic and riparian habitats including potential habitat loss for special-status species. Planting of native riparian vegetation could offset some of these impacts. Tree removal under Corps new Vegetation policy will have adverse environmental impacts.

*Permitting Considerations?*

Ongoing

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

None

**Social Considerations:**

*Public Safety?*

Likely to improve public safety due to improved levee performance.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

Unlikely to provide other benefits besides improved levee performance and maintenance.

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Likely acceptable at State level

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

No redirected hydraulic impacts.

*Residual Risk?*

Residual risk will decrease.

*Climate Change Adaptability:*

This action would increase hydrologic adaptability by moderating potential damage, and could increase or decrease biological adaptability depending on existing habitat conditions and design of individual actions (e.g., extent of riparian and aquatic habitat removed vs. added), which together would determine the effect on habitat extent, connectivity, and complexity.

**Urban, Small Community, and Non-Urban Considerations:**

No specific considerations identified.

**Regional Applicability:**

All regions

**Integration with Other Programs:**

Small erosion repairs permit program (FMO), integration with federal; Sacramento Bank Protection, CalfedDelta Levee Stability and Corps PL84-99 Programs.

**References:**

Draft Levee Repairs Interim Framework; (FEAT, 1997a); (DWR, 2005b); Sacramento River Bank Protection Project Draft Environmental Assessment/Initial Study for Levee Repair of 25 erosion sites;Flood Warning: Responding to California's Flood Crisis.

# DRAFT Management Action Evaluation

**Management Action Title:** MA-038

Revise O&M manuals and inspection criteria to promote best maintenance practices that support multi-benefits of the flood system.

**Description:**

*Problem:*

Outdated O&M manuals do not reflect the best maintenance practices to inspect, operate, and maintain levees most effectively. Many existing O&M manuals were prepared specifically to reduce flood risks, often with little consideration about how those O&M activities might affect other functions of the flood management system, including ecosystem functions.

Desired Outcome:

O&M manuals reflecting best maintenance practices and scientific based approach to multi-benefit management of the flood management system, and are in compliance with current laws and regulations.

*Methodology:*

Revise O&M manuals using the best available scientific and technical data to support multiple objectives and ecosystem benefits. The new O&M manuals should be complimentary to the multiple benefit system-wide flood management plan. While keeping public safety, flood system functionality/efficiency priorities, O&M manuals should not conflict with other uses of the system, such as water supply or ecosystem health. Operations and Maintenance documents should be reviewed and updated to reflect current maintenance intervals, laws, regulations, and policies. Levee inspection criteria should be modified or tiered based on the type of land use protected by the levee (urban, rural, or agricultural). Existing inspection criteria should be strengthened to include determination and location of non-standard levee sections and to implement repairs and/or replacements. Identify best management practices to prevent and minimize encroachments.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☑ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☑ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retained for further evaluation; look for opportunities to combine with management actions involving setback levees, ecosystem restoration, and floodplain storage.

**Advantages:**

- Establishing the framework for maintenance and operation of the flood control works in conjunction public trust issues may lower cost.

**Disadvantages:**

- Conflicting State and Federal policies related to vegetation on levee.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Low to Medium, depending on the number of manuals that need to be, and can be, updated to achieve these goals. Costs will include stakeholder engagement, modeling and assessment of different approaches, and finalizing the improved manuals. Revision of O&M manual may require congressional and State legislation to redefine the State-federal flood management for California.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

Updating O&M manuals can decrease costs to operate/maintain/repair the flood system, as the revised manuals will better reflect existing conditions. Over the long term revisions could result in an increased workload and cost implications to the FMO office.

*Potential for Cost-Sharing?*

Potential for cost sharing with local agencies and Federal flood agencies.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

Updating O&M manuals to reflect existing conditions has potential to reduce flood frequency and decrease emergency response and recovery costs.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

Potential to reduce the frequency (and long-term cost) of flooding.

*Effect on Damage to Critical Public Infrastructure?*

Region specific (cannot determine at this time)

*Effect on Floodplain and Economic Development?*

Potential increase pressure from development if the risk of flooding is decreased.

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

Improved O&M has the potential to reduce the frequency (and long-term cost) of flooding. No significant change of effect on State flood responsibility.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

Including the enhancement of physical processes and ecosystem function in O&M could rehabilitate those processes and functions, because currently multiple objectives are not optimized in O&M, which generally has a single FM focus.

*Adverse Environmental Impact?*

None

*Permitting Considerations?*

None

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

Impacts associated with flood system O&M could be reduced because O&M would be better facilitated and mitigation better coordinated.

**Social Considerations:**

*Public Safety?*

Potential to reduce frequency of flooding and improve level of flood protection by updating O&M manuals.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

Potential to provide recreation, open space, and water supply benefits. Review of O&M criteria would also be an opportunity to evaluate potential benefits to recreation and fish and wildlife enhancement that could persist after flood season is over.

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Potential; however, concerns over limiting the flexibility to maintain integrity of the flood management system must be overcome.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

Potential upstream and downstream hydraulic impacts if new O&M manuals call for altered flow regimes and storage requirements.

*Residual Risk?*

May reduce the frequency of flooding, reducing residual risk to existing development.

*Climate Change Adaptability:*

This action could increase biological adaptability by increasing opportunities to provide habitat, or increase habitat quality (e.g., by increasing connectivity or complexity), and thus, sustain populations under a range of conditions, including extreme flow events.

**Urban, Small Community, and Non-Urban Considerations:**

No specific considerations identified.

**Regional Applicability:**

Not applicable in Delta Region, but may be used to reduce hydraulic impacts to Delta.

**Integration with Other Programs:**

Corridor Management Strategy (FMO)

**References:**

Environmental Sustainability Summary;

# DRAFT Management Action Evaluation

**Management Action Title:** MA-083

Effectively maintain and operate closure structures.

**Description:**

*Problem:*

The levee control system is not a continuous embankment with a well defined and established levee crown elevation throughout. Throughout the system, levees are interrupted by crossings and other at-grade penetrations that lower the top-of-levee elevation. Such crossings include railroad tracks, roads and highways. Many of these levee gaps are fitted with structures that would be closed during periods of high water to prevent inundation of the protected area. Other gaps do not have such closure structures. Some closure structures installed have not been maintained to allow functional operation during flood events.

Desired Outcome:

All gaps in levee alignment will be evaluated periodically. and new closure structures will be installed at gaps where warranted. All closure structures will be operated and inspected at pre-established regular intervals to ensure the structures will function during flood events.

*Methodology:*

All gaps on the levee control system need to be identified, and local agencies must evaluate gaps without closure structures to assess whether a structure is warranted. Existing closure structures need to be evaluated for deficiencies in design and maintenance and need to be operated on a regular basis to make sure they will operate effectively during emergencies. For each existing or potential structure, the structure operator(s) and affected transportation corridor must be identified. The State needs to establish closure structure operation drill and inspection protocols to be carried out by local structure operators.

**CVFPP Goals**

*Contributes Significantly to:* Improve Operation and Maintenance

**Potentially Contributes to (Check all that apply):**

- ☑ Improve Flood Risk Management
- ☑ Improve Operation and Maintenance
- ☐ Promote Ecosystem Functions
- ☐ Improve Institutional Support
- ☐ Promote Multi-Benefit Projects

**Recommendations (Retained/Not Retained/Requires Further Evaluation):**

Retained for further evaluation.

**Advantages:**

Closure structures in good conditions and with available crews to activate them are effective in preventing inundation.

**Disadvantages:**

Time, money and coordination required to activate and erect the structures. Disruption in transportation.

**Economic Considerations:**

*Capital Cost? (High, Medium, Low)*

Low. Closure structures are not expensive to design and install. The cost to upgrade existing structures is equally low.

*Annual Cost to Operate/Maintain/Repair? (Increase, Decrease, or No Change)*

Very low. Annual costs are associated with operational drills and upgrades to the closure structures.

*Potential for Cost-Sharing?*

Potential for cost sharing with local agencies and Federal flood agencies.

*Emergency Response and Recovery Costs? (Increase, Decrease, or No Significant Change)*

Low. Criteria and a well established protocol for activation of closure structures should be included in any emergency response plan. Although closure structures often block transportation routes, which may be used for evacuation, coordinating structure operations protocol with emergency response plans is likely to reduce the need for or frequency of evacuations.

*Flood fighting? (Increase, Decrease, or No Significant Change)*

Flood fighting must be exercised on system gaps that do not have closure structures, so this action would reduce flood fighting costs.

*Effect on Damage to Critical Public Infrastructure?*

Failure to effectively close gaps may result in inundation of a protected area and potential damage to any infrastructure lying within.

*Effect on Floodplain and Economic Development?*

None

*Effect on State Flood Responsibility? (Increase, Decrease, or No Significant Change)*

While the State may not be directly responsible for the operation and maintenance of closure structures, it is in the State's interest to make sure that closure structures will successfully operate and close off levee gaps to prevent inundation during high-water events.

**Environmental Considerations:**

*Rehabilitate key physical processes and ecological functions?*

None

*Adverse Environmental Impact?*

None

*Permitting Considerations?*

Drill and/or emergency operation of closure structures may require permits and coordination with agencies and other entities affected by the structure, such as the California Department of Transportation, counties and municipalities, and rail companies.

*Opportunity to Reduce the Adverse Environmental Impacts Associated With Operation, Ongoing Maintenance, and Repairs of FM System?*

None

**Social Considerations:**

*Public Safety?*

High potential to reduce the consequences of flooding and to protect public safety by preventing inundation.

*Potential to Provide Other Benefits (Water Supply, Recreation, or Open Space)?*

None

*Likelihood of Implementation (Politically, Institutionally, and Culturally Acceptable)?*

Very likely. Existing closure structures may need to be upgraded and all need to be operated on a regular basis. The USACE requires that all closure structures be in good conditions and that trial erections have been accomplished in accordance with related O&M manuals.

**Technical Considerations:**

*Redirected Hydraulic Impacts?*

None

*Residual Risk?*

Failure to recognize gaps in the system and ensure operation of closure structures will increase the residual risk.

*Climate Change Adaptability:*

None

**Urban, Small Community, and Non-Urban Considerations:**

Operation of closure structures (during trials and emergencies) is likely to disrupt the transportation network. Activation of closure structures is a consorted effort between the operator and transportation entities affected by the closure.

**Regional Applicability:**

Applicable to all regions.

**Integration with Other Programs:**

None

**References:**